Missouri Department of Natural Resources

Biological Assessment Report

South Wyaconda River
Scotland and Clark Counties

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Prepared for:

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Branch

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1.0 Introduction

At the request of the Water Protection Program (**WPP**), the Environmental Services Program's (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a biological assessment of the South Wyaconda River, which flows through mostly rural portions of Davis County, Iowa as well as Scotland and Clark counties, Missouri. A total of 9 miles of South Wyaconda River was added to the 303(d) List of Impaired Waters due to sediment resulting from agricultural non-point source pollution.

Sampling at South Wyaconda River was conducted on September 21-22, 2004 and April 6, 2005 to provide data to the WPP for use in evaluating and comparing the biological integrity of the stream. Dave Michaelson and Ken Lister of the Environmental Services Program, Field Services Division conducted the sampling.

The goal of this study was to test the following three null hypotheses:

1) Macroinvertebrate assemblages will not differ among reaches of South Wyaconda River from upstream to downstream;

2) Water chemistry will not differ among reaches of South Wyaconda River from upstream to downstream;

3) The macroinvertebrate assemblage of South Wyaconda River will not differ from that found in biological criteria reference streams.

2.0 Study Area

The South Wyaconda watershed originates in Davis County, Iowa, south of the town of West Grove. The upper portion of the river flows east, then proceeds in a southeasterly direction toward its confluence with the North Wyaconda River to form the Wyaconda River south of Luray in Clark County, Missouri. The South Wyaconda River is approximately 45 miles long and lies within an approximately 164 square mile watershed which is mostly rural, dominated by grassland and crops. See Table 1 for a comparison of land use for the South Wyaconda watershed, the Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers Ecological Drainage Unit (**EDU**), and the biocriteria reference streams used for comparison in this study.

Throughout most of its length, the South Wyaconda River has been altered in some form. In the upper reaches of the watershed, channel and watershed alterations were carried out as described in the Soil Conservation Service's (**SCS**) Big Wyacondah [*sic*] Watershed Project (SCS 1962). The SCS project included work throughout the entire unchannelized upper watershed in Davis County, Iowa as well as extending downstream into channelized reaches. This project was initiated by the SCS under the authority of the Watershed Protection and Flood Prevention Act (PL-83-566) for the purposes, as the title

of the act indicates, of watershed protection and flood prevention. The objectives of the plan included the construction of two large floodwater retarding structures (31.5 and 39 acres), 54 drop inlet structures (smaller impoundments in the style of farm ponds), and 3.9 miles of tributary channelization. In addition, 40 farm ponds were to be built, supplementing the 175 ponds already in existence in 1962. This project began in 1957, with work ending in 1979 (MDC 2005).

Efforts described above which were undertaken to slow soil erosion and minimize flood damage in the upper reaches added to an already altered South Wyaconda watershed. By some estimates, as much as 86 percent of the river has been channelized (MDC 2005). Many of the reaches bypassed by channelization have filled in to such a degree that it is difficult to assess where the old channel lies using topographic maps and aerial photographs. As a result, accurately comparing pre-channelization gradient with the existing gradient of 6.9 ft/mile (MDC 2005) would be difficult.

The South Wyaconda River is located in the Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU. An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. Please see Appendix A for maps of the EDU and the 11-digit Hydrologic Unit, 07110001090, which delineate the South Wyaconda watershed. All of the South Wyaconda River sampling stations are located within a reach designated class "P" with beneficial use designations of "livestock and wildlife watering," "protection of warm water aquatic life and human health—fish consumption," and "drinking water supply."

Table 1
Percent Land Cover

	Urban	Crops	Grassland	Forest
PMSDM EDU*	3	42	29	19
S. Wyaconda R.	<1	42	47	10
Middle Fabius R.	1	35	36	23
North R.	1	32	31	31
Little Fox R.	1	29	35	30

*Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers Ecological Drainage Unit

3.0 Site Descriptions

A total of three stations were placed along the survey reach. The downstream station was located in Lewis County, approximately 2.5 miles upstream from the North Wyaconda confluence. The remaining two stations were in Scotland County. Discharge measurements during the survey period are given for each sampling station in Table 2 in the Data Results section. Channel measurements recorded at each station are presented in Table 8 in the Data Results section.

South Wyaconda #1 (NE ¼ sec. 28, T. 65 N., R. 9 W.) was located downstream of the County Road 110 bridge. A very narrow riparian corridor was present on both sides of the river, separating it from crop fields along each bank. Geographic coordinates at the upstream terminus of this site were Lat. 40.412412º, Long. –91.901369º.

South Wyaconda #2 (SE ¼ sec. 14, T. 65 N., R. 10 W.) was located downstream of the County Road 405 concrete slab crossing. The riparian corridor on the right descending bank was several hundred feet wide and was in good condition. Along the left bank the riparain corridor was also good, with approximately 50-100 feet of forested habitat along the reach. Crop fields are present along both banks beyond the tree line. Geographic coordinates at the upstream terminus of this site were Lat. 40.438829º, Long. –91.970132º.

South Wyaconda #3 (SW ¼ sec. 4, T. 65 N., R. 10 W.) was located downstream of the State Road H bridge and downstream of an unnamed tributary entering the river from the south, marking the beginning of the 303(d)-listed reach. A narrow riparian corridor separates the river from a crop field on the left descending bank. Toward the end of the survey reach, the left bank has an outside bend that is actively eroding. Erosion in this section of stream is exacerbated by the lack of trees along the bank. The right bank also has a narrow band of trees, with a grassy field beyond. Geographic coordinates at the upstream terminus of this site were Lat. 40.467861º, Long. –92.014839º.

4.0 Methods

4.1 Macroinvertebrate Collection and Analyses

A standardized sample collection procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (MDNR 2003b). Three standard substrates—depositional substrate in non-flowing water, rootmat at the stream edge, and large woody debris—were sampled at all locations.

A standardized sample analysis procedure was followed as described in the SMSBPP. The following four metrics were used: 1) Taxa Richness (TR); 2) total number of taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera (EPTT); 3) Biotic Index (BI); and 4) Shannon Diversity Index (SDI). These metrics are scored and combined to form the Stream Condition Index (SCI). Stream Condition Indices between 20-16 qualify as biologically supporting, between 14-10 are partially supporting, and 8-4 are considered non-supporting of aquatic life. The multi-habitat macroinvertebrate data are presented in Appendix D as laboratory bench sheets.

Additionally, macroinvertebrate data were analyzed to make comparisons among longitudinal reaches. This comparison addresses influences that may result from influxes from such sources as stormwater, wastewater, and tributaries. Data are summarized and presented in tabular format comparing means of the four standard metrics and other

parameters at each of the stations on South Wyaconda River. Finally, the data from South Wyaconda were compared to biological criteria from reference streams within the same watershed size classification and within the same EDU.

4.2 Physicochemical Data Collection and Analysis

During each survey period, *in situ* water quality measurements were collected at all stations. Field measurements included temperature (ºC), dissolved oxygen (mg/L), conductivity (µS/cm), and pH. Additionally, water samples were collected and analyzed by ESP's Chemical Analysis Section for turbidity (NTU), chloride, total phosphorus, ammonia-N, nitrate+nitrite-N, and total Kjeldahl nitrogen (TKN) (with the exception of turbidity, all parameters are reported in mg/L). Procedures outlined in Field Sheet and Chain of Custody Record (MDNR 2001) and Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003d) were followed when collecting water quality samples. Stream velocity was measured at each station during the survey period using a Marsh-McBirney Flo-Mate™ Model 2000. Discharge was calculated per the methods in the Standard Operating Procedure MDNR-FSS-113, Flow Measurement in Open Channels (MDNR 2003a). Physicochemical data were summarized and presented in tabular form in Tables 4, 5, 6, and 7 for comparison among stations on South Wyaconda River.

4.3 Habitat Assessment

Stream habitat characteristics for each sampling station were measured during the spring 2004 survey period using a standardized assessment procedure as described for glide/pool habitat in the Stream Habitat Assessment Project Procedure (MDNR 2003c).

4.4 Sinuosity

Sinuosity was used as an indicator of the amount of channelization that had taken place. Using the National Hydrography Dataset (**NHD**) and Arcmap® software, the sampling station was placed in the approximate middle of a two-mile stream segment and sinuosity was measured by calculating the ratio of the stream length distance divided by the straight-line distance.

4.5 Channel Measurements

Lack of instream habitat can be observed in northern Missouri streams that are wide and shallow. Wider, shallower streams tend to have less ability to retain pools and woody debris (Haithcoat et al. 2003). At each sampling station, a series of 10 bank-to-bank transects was established. Each transect was equally spaced within the sampling reach, which is 20x the average width. Measurements taken at each transect included lower bank width ["lower bank" as defined in the Stream Habitat Assessment Project Procedure (MDNR 2003c)], wetted width, and water depth at ¼, ½, and ¾ of the distance across the

wetted width. To document critical habitat conditions, measurements were collected during the fall low flow period.

4.6 Quality Assurance/Quality Control (QA/QC)

QA/QC procedures were followed as described in the SMSBPP and in accordance with the Fiscal Year 2004 Quality Assurance Project Plan for "Biological Assessment."

5.0 Data Results

5.1 Physicochemical Data

Measurable flow was observed at each station during both sample seasons, with flow increasing while progressing downstream during each season. Discharge was considerably higher during the spring sample season, being between two and three times higher than flow measured in fall.

Table 2
Discharge Measurements of the South Wyaconda River Sample Stations

Station	Fall 2004 Flow (cfs)	Spring 2005 Flow (cfs)
1	7.2	17.1
2	6.1	15.1
3	3.9	11.4

In situ water quality measurements are summarized in Table 3 and Table 4. Temperature readings varied seasonally, with mean temperatures being only slightly higher in the fall (18.0ºC) compared to the mean spring temperature (15.0ºC). Temperatures were slightly higher in downstream stations compared to Station 3 in the fall, but there was only a 2.5ºC difference among stations. During the spring season, temperatures were identical among stations.

Although turbidity readings were higher in fall samples compared to spring samples, this difference was slight. Turbidity differences among sites were very small when compared within seasons. The largest turbidity difference of 3.48 NTU existed between Station 1 and Station 2 spring samples.

Only minor differences existed in pH readings among seasons, with spring readings being slightly higher. Extremes among all readings varied by 0.35 units, whereas the largest within-season pH difference was 0.20 units.

Conductivity readings and dissolved oxygen concentrations also were higher during the spring sample season at all stations. During both seasons, conductivity was lowest at the downstream station and highest at the upstream station. Although this trend was

consistent among seasons, the differences among readings were small. Dissolved oxygen concentrations exhibited no such trends.

Table 3
Fall 2004 *In situ* South Wyaconda River Water Quality Measurements

	Parameter				
Station	Temperature (ºC)	Dissolved O_2 (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)
1	18.5	8.94	455	7.88	4.99
2	19.0	9.28	477	7.90	8.47
3	16.5	8.40	503	7.85	6.29

Table 4
Spring 2005 *In situ* South Wyaconda River Water Quality Measurements

	Parameter				
Station	Temperature (ºC)	Dissolved O_2 (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)
1	15.0	10.1	525	8.00	3.60
2	15.0	10.4	539	8.10	4.67
3	15.0	10.2	556	8.20	4.45

Nutrient as well as chloride concentrations are presented in Table 5 (fall 2004) and Table 6 (spring 2005). Nutrient and chloride concentrations were largely consistent among sites and among seasons, with the exception that TKN concentrations were slightly higher in spring samples and nitrate+nitrite as nitrogen was highest at Station 3 in spring. Phosphorus levels were low and similar among seasons and nitrogen as ammonia concentrations were below detectable levels at all sites during both sample seasons.

Table 5
Fall 2004 South Wyaconda River Nutrient Concentrations

	Parameter (mg/L)				
Station	NH_3-N	NO_3+NO_2-N	TKN	Total Phosphorus	Chloride
1	0.03*	0.02	0.42	0.09	16.2
2	0.03*	0.01	0.37	0.09	15.9
3	0.03*	0.02	0.39	0.11	15.9

*Below detectable levels

Table 6
Spring 2005 South Wyaconda River Nutrient Concentrations

	Parameter (mg/L)				
Station	NH_3-N	NO_3+NO_2-N	TKN	Total Phosphorus	Chloride
1	0.03*	0.01	0.52	0.07	17.3
2	0.03*	0.06	0.64	0.06	17.7
3	0.03*	0.11	0.64	0.07	17.5

*Below detectable levels

5.2 Habitat Assessment

Habitat assessment scores were recorded for each sampling station. Results are presented in Table 7. According to the project procedure, for a study site to fully support a biological community, the total score from the physical habitat assessment should be 75% to 100% similar to the total score of a reference site. The habitat score for Little Fox River, the biocriteria reference stream used for comparison, was 74. Because all South Wyaconda River stations had habitat scores that exceeded or were within the required range of similarity, it was inferred that the sites should support comparable biological communities.

Table 7
Reference Streams and South Wyaconda River Habitat Assessment Scores

Reference Stream	Habitat Score	S. Wyaconda R. Sample Stations	Habitat Score	% of Mean Reference
Little Fox River	74	1	66	89
		2	86	116
		3	80	108

5.3 Sinuosity and Channel Measurements

Sinuosity measurements near 1.0 are considered potentially channelized. The sinuosity of South Wyaconda River within our sample reach ranges from 1.01 to 1.04 (Table 8). In addition to these sinuosity measurements and our visual inspection of aerial photographs suggesting past channelization, literature exists that documents the planning and implementation of channel-straightening efforts of various parts of the South Wyaconda River (e.g. SCS 1962, USACE undated website).

Typically, measurements such as average stream width increase with increasing watershed size. This study demonstrates that the South Wyaconda River, within our study reach, does not follow this trend. Channel width was greatest at the middle station, whereas the remaining stations were nearly the same. Other channel measurements, such as average depth, average wetted width, maximum depth, and standard deviation of depth do not necessarily reflect trends associated with size. These measurements were variable

among sites, with no trends associated with the stations' position in the watershed (Table 8).

Ratios of several stream measurements were calculated in an effort to conduct further comparisons among sample stations. Ratios can standardize measurements so that parameters such as channel width can be used for comparison of sample stations, regardless of their longitudinal placement. The ratios of channel width to wetted width and wetted width to average depth are given in Table 8. These ratios would assist in demonstrating certain stream channel characteristics as indicators of habitat quality (e.g. a higher wetted width to average depth ratio may reflect a wide, shallow stream with poorer habitat for aquatic biota). The ratio of channel width to wetted width is greatest at Station 2, resulting from a smaller wetted channel within a wider bank-to-bank channel. The ratio of wetted width to depth is also greatest at Station 2, which indicates that the river at this site is wider and shallower compared to the other sites, an indication reinforced by the relatively shallow average depth at this site.

Table 8
Stream Measurement Summary

South Wyaconda Station	Avg. Channel Width (ft)	Avg. Wetted Width (ft)	Avg. Depth of Stream (ft)	Maximum Depth (ft)	Ratio Channel Width to Wetted Width	Ratio Wetted Width to Depth	Standard Deviation of Depth	Sinuosity
1	63.5	36.8	0.61	1.97	1.73	60.53	0.44	1.01
2	71.9	28.7	0.31	0.75	2.51	91.11	0.19	1.02
3	60.7	33.5	0.39	2.08	1.81	85.75	0.43	1.04
Reference	46.7	25.1	0.9	2.7	2.4	31.0	0.7	1.49

Table 8 also includes mean channel measurement values for northern Missouri reference streams (MDNR 2005). Although no statistical comparison was performed as part of this report, a numerical comparison of the data demonstrates some differences between reference streams and the South Wyaconda River study stations. Average reference measurements that are outside the range of all South Wyaconda River values include maximum depth, ratio of wetted width to depth, and standard deviation of depth. These values indicate that all South Wyaconda River sampling stations have shallower maximum depths, wider and shallower channels, and more homogeneous water depths than the references.

5.4 Biological Assessment

5.4.1 South Wyaconda Longitudinal Comparison

Metrics calculated for South Wyaconda River were compared to biological criteria based on reference sites from the Plains/Mississippi Tributaries between the Des Moines and

Missouri Rivers EDU. These criteria for fall and spring sample seasons, presented in Tables 9 and 10, were used to assess the overall health of the aquatic community relative to reference communities within these EDUs.

Table 9
Biological Criteria for Warm Water Reference Streams in the Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU, Fall Season

	Score = 5	Score = 3	Score = 1
TR	>57	57-28	<28
EPTT	>10	10-5	<5
BI	<6.87	6.87-8.43	>8.43
SDI	>3.01	3.01-1.50	<1.50

Table 10
Biological Criteria for Warm Water Reference Streams in the Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU, Spring Season

	Score = 5	Score = 3	Score = 1
TR	>46	46-23	<23
EPTT	>7	7-4	<4
BI	<7.26	7.26-8.63	>8.63
SDI	>2.30	2.30-1.15	<1.15

Many of the biological metrics for fall 2004 samples were similar among South Wyaconda River sites (Table 11). Taxa Richness was the most variable metric, with the highest values occurring at Station 2. Despite the variability of Taxa Richness metrics, the differences were insufficient to affect scores. The remaining metrics also exhibited no longitudinal trends and were nearly identical among sites.

Table 11
South Wyaconda River Metric Values and Scores, Fall 2004 Season, Using Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU Biological Criteria Reference Data

Site	TR	EPTT	BI	SDI	SCI	Support
#1 Value	76	17	6.31	3.06		
#1 Score	5	5	5	5	20	**Full**
#2 Value	85	19	6.28	3.20		
#2 Score	5	5	5	5	20	**Full**
#3 Value	68	18	6.41	3.18		
#3 Score	5	5	5	5	20	**Full**

As was the case for fall data, biological metrics for spring 2005 were very similar among sites, with Taxa Richness being the most variable metric (Table 12). Taxa Richness values were identical among Station 2 and Station 3, whereas fewer taxa were collected

at Station 1. Scores among sites and among metrics were the same, with each station achieving the highest possible score and attaining fully supporting status.

Table 12
South Wyaconda River Metric Values and Scores, Spring 2005 Season, Using Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU Biological Criteria Reference Data

Site	TR	EPTT	BI	SDI	SCI	Support
#1 Value	50	8	6.78	2.62		
#1 Score	5	5	5	5	20	**Full**
#2 Value	56	8	7.01	2.79		
#2 Score	5	5	5	5	20	**Full**
#3 Value	56	11	6.77	2.80		
#3 Score	5	5	5	5	20	**Full**

5.4.2 Macroinvertebrate Percent and Community Composition

Macroinvertebrate Taxa Richness, EPT Taxa, and percent EPT are presented in Table 13 and Table 14. These tables also provide percent composition data for the five dominant macroinvertebrate families at each South Wyaconda River station. The percent relative abundance data were averaged from the sum of three macroinvertebrate habitats—nonflow, large woody debris, and rootmat—sampled at each station.

Fall 2004 macroinvertebrate samples from South Wyaconda River averaged 76 total taxa (range 68-76) and 18 EPT Taxa (range 17-19). Midge larvae (Chironomidae) were the dominant taxa at all sites. The same five taxonomic families were counted among the most numerous at all sites. Aside from Chironomidae, which accounted for the majority of taxa at all sites, the remaining dominant families included three families of mayflies (Ephemeroptera) and one caddisfly (Trichoptera) family.

Table 13
Fall 2004 South Wyaconda River Macroinvertebrate Composition

Variable-Station	1	2	3
Taxa Richness	76	85	68
Number EPT Taxa	17	19	18
% Ephemeroptera	18.1	21.7	23.0
% Plecoptera	0.0	0.0	0.0
% Trichoptera	5.7	10.2	5.7
% Dominant Families			
Chironomidae	69.8	61.9	65.0
Leptophlebiidae	6.8	7.3	5.6
Caenidae	5.2	7.3	10.5
Hydropsychidae	3.3	8.7	4.7
Baetidae	2.8	4.2	3.1

Spring 2005 macroinvertebrate samples averaged 54 total taxa (range 50-56) and 9 EPT Taxa (range 8-11) (Table 14). Chironomids were the dominant taxa at all stations, making up nearly 90 percent of individuals present in samples. The remaining taxonomic families were present in varying percentages, with four families among the dominant taxa at all three stations.

Table 14
Spring 2005 South Wyaconda River Macroinvertebrate Composition

Variable-Station	1	2	3
Taxa Richness	50	56	56
Number EPT Taxa	8	8	11
% Ephemeroptera	4.6	4.1	6.7
% Plecoptera	0.0	0.0	0.1
% Trichoptera	3.4	1.1	1.2
% Dominant Families			
Chironomidae	88.7	90.8	89.0
Hydropsychidae	3.1	0.8	1.2
Caenidae	2.3	2.0	1.0
Baetidae	1.5	1.0	3.6
Gomphidae	0.5	--	--
Leptophlebiidae	--	0.9	--
Heptageniidae	--	--	1.1

5.4.3 Comparisons of South Wyaconda River versus Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU Biological Criteria Reference Sites

Macroinvertebrate data for two biocriteria reference streams sampled in fall between 1999 and 2000 are presented in Table 15. Spring macroinvertebrate data collected at four sample stations at three biocriteria reference streams are presented in Table 16. Taxa Richness averaged 69 (range 57-83) in fall and 57 (range 38-72) in spring samples. Total EPT Taxa averaged 12 (range 7-16) in fall and 11 (range 5-15) in spring samples.

Fall 2004 South Wyaconda River macroinvertebrate metrics were comparable to, and in some cases exceeded, those of the biological criteria reference sites. The lowest Taxa Richness value for South Wyaconda (68) was nearly equal to the middle value observed among reference samples, whereas the highest Taxa Richness value (85) was slightly higher than the highest reference value. Mean Taxa Richness for the South Wyaconda sites (76) was considerably higher than the mean for the reference sites (69). South Wyaconda mean EPT Taxa (18) also was higher than that of the reference streams (12). The lowest EPT Taxa value among the three South Wyaconda sites (17) was higher than the highest among the reference sites (16). Although there tended to be more EPT Taxa among the South Wyaconda sites, mayflies generally made up similar percentages of the total sample relative to reference sites and stoneflies were absent among all sites. Compared to the references, caddisflies tended to account for a larger percentage of

individuals in samples among South Wyaconda sites. Chironomids were the most numerous taxa at all three South Wyaconda River sites in fall 2004 and tended to make up a higher percentage of individuals present in samples than most of the references. Two mayfly families—Caenidae and Leptophlebiidae—each were among the five dominant families at each South Wyaconda site; by comparison, only one reference site had mayflies present among the dominant families.

Table 15
Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU
Biocriteria Reference Stream Macroinvertebrate Composition, Fall Season

	Middle Fabius River		Little Fox River
Sample Year	1999	2000	1999
Station-Variable	1	1	1
Taxa Richness	67	57	83
Number EPT	14	7	16
% Ephemeroptera	26.0	6.2	20.0
% Plecoptera	0.0	0.0	0.0
% Trichoptera	2.5	0.5	1.2
% Dominant Families			
Chironomidae	30.8	42.4	60.4
Leptophlebiidae	11.1	--	8.2
Elmidae	9.7	6.6	--
Corixidae	9.2	--	--
Caenidae	8.7	--	6.8
Hyalellidae	--	23.9	--
Arachnoidea	--	8.2	--
Tubificidae	--	3.8	--
Physidae	--	--	6.8
Coenagrionidae	--	--	3.2

South Wyaconda River spring 2005 macroinvertebrate metrics were comparable to the middle to low range of reference site values (Table 16). South Wyaconda Taxa Richness and EPT Taxa values were similar to sites that ranked in the middle among reference sites. Mayflies accounted for a much lower percentage of individuals in samples compared to all but one reference sample. Stoneflies also were relatively scarce in South Wyaconda samples, with only a single individual observed among all samples. At least two reference samples, however, exhibited a similar scarcity of stoneflies. Caddisflies were present in slightly higher percentages in South Wyaconda samples than most references. Chironomids were the dominant taxa group at South Wyaconda River and among each of the spring reference samples. By comparison, however, chironomids were present in much higher percentages at South Wyaconda sites than all but one of the references.

Table 16
Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU
Biocriteria Reference Stream Macroinvertebrate Composition, Spring Season

	Middle Fabius River			North River		Little Fox River	
Sample Year	1999	2000	2001	2001		1999	2001
Station-Variable	1	1	1	1	2	1	1
Taxa Richness	66	49	72	63	61	50	38
Number EPT	15	7	14	11	13	11	5
% Ephemeroptera	44.5	4.3	30.2	14.4	18.4	10.6	19.1
% Plecoptera	5.2	0.0	0.4	1.4	0.3	2.0	0.1
% Trichoptera	1.6	0.5	0.3	0.1	0.4	1.1	0.1
% Dominant Families							
Chironomidae	31.5	82.2	52.5	65.2	63.3	60.7	75.3
Caenidae	21.0	4.0	26.5	11.4	17.4	5.5	18.4
Baetidae	10.4	--	--	2.4	--	--	--
Leptophlebiidae	5.9	--	--	--	--	--	--
Heptageniidae	5.7	--	--	--	--	1.9	--
Hyalellidae	--	2.8	--	--	--	--	--
Elmidae	--	2.7	2.8	4.2	4.1	--	--
Planariidae	--	2.5	--	--	--	--	--
Arachnoidea	--	--	2.7	--	--	--	--
Tubificidae	--	--	2.5	--	---	--	--
Simuliidae	--	--	--	1.9	2.4	18.5	1.2
Coenagrionidae	--	--	--	--	2.5	--	--
Gomphidae	--	--	--	--	--	2.2	--
Enchytraeidae	--	--	--	--	--	--	0.9
Ceratopogonidae	--	--	--	--	--	--	0.7

6.0 Discussion

Non-nutrient water quality parameters were fairly consistent among South Wyaconda River stations during both sample seasons. As expected, higher dissolved oxygen associated with lower temperature was observed during the spring season. There were few differences among the remaining non-nutrient parameters, even between seasons. Nutrient and chloride concentrations also were consistent among sites and between seasons. The only exception was that NO_3+NO_2-N concentrations were highest at the upstream two stations in spring samples, but at Station 1 returned to levels comparable to those observed at all stations in the fall. Station 3, which had the highest NO_3+NO_2-N concentrations, was located near the town of Arbela and was the only site that was in close proximity to any towns. Arbela has no permitted wastewater treatment facility and, because none of the other nutrient parameters associated with wastewater influence were elevated, it is unlikely that this community was contributing to the slightly higher NO_3+NO_2-N readings. A farm located along the left descending bank is another possible

source of the elevated nitrogen concentrations at Station 3. Although agriculture is the primary land use in the South Wyaconda watershed, the field adjacent to Station 3 had a higher gradient than those observed at the remaining stations and the riparian zone separating the river from the field was fairly narrow. Possibly, spring rains mobilized some portion of the residual nitrogen present in crop fields in the upper watershed, resulting in the slightly elevated NO_3+NO_2-N concentrations observed.

Channel dimension measurements indicate that average wetted width and average channel width of reference streams are less than those of South Wyaconda. These measurements alone do not support any definitive conclusions, as the watershed size contributing to each of the South Wyaconda stations is larger than the average among references. Stream measurement features that best demonstrated a difference between South Wyaconda and the reference streams were average depth, standard deviation of depth, sinuosity, and the wetted width to depth ratio. These measurements describe the channelized South Wyaconda River as lacking in habitat variability in terms of depth heterogeneity, having an overall channel that is wider and shallower than the surveyed reference streams, and having a much less sinuous channel pattern.

Despite the fact that South Wyaconda may be lacking some aquatic habitat features based on channel morphology measurements described above, the overall bioassessment conducted for this study shows no biological impairment. Each station during both sample seasons achieved the highest possible stream condition index score (SCI=20), indicating that the South Wyaconda River is fully supporting of aquatic life. Although macroinvertebrate communities in streams with rock substrate change in response to sediment input (Zweig and Rabeni 2001), many northern Missouri stream bottoms are dominated by substrate considered by many researchers to actually be sediment (i.e. silt and sand). As is typical of many northern Missouri streams (including many of those used as biological references), the dominant benthic substrate of South Wyaconda is sand. Thus, benthic habitat available to macroinvertebrates was similar among South Wyaconda sites compared to habitat in reference streams. This factor at least partly explains the South Wyaconda macroinvertebrate community's similarity to reference streams as observed in this study. Despite the macroinvertebrate community's relatively robust scores among South Wyaconda sites, certain habitat deficiencies may go unnoticed by focusing on this single bioassessment method. As discussed above, the South Wyaconda River has several channel morphology features that are different compared to reference streams. Two features, standard deviation of depth and wetted width to depth ratio, reinforce what was observed in the field—a shallow, homogeneous river with little potential for supporting a complex fish community including top predators. A lack of top predator fish species has been shown to correspond well with the lack of pools commonly observed in channelized streams (MDNR 2005). Therefore, it may be beneficial to incorporate a fisheries index of biotic integrity (e.g. Karr et al. 1986; MDC 2003) for streams assessments that are conducted for habitat impairment.

7.0 Conclusions

This study was conducted to test three null hypotheses that were presented in the Introduction section: 1) macroinvertebrate assemblages will not differ among reaches of South Wyaconda River from upstream to downstream; 2) water chemistry will not differ among reaches of South Wyaconda River from upstream to downstream; 3) the macroinvertebrate assemblage of South Wyaconda River will not differ from that found in biological criteria reference streams.

Because the macroinvertebrate community of South Wyaconda River did not differ appreciably among sample reaches or from reference streams, the null hypotheses regarding macroinvertebrates is accepted. The null hypothesis concerning water chemistry also is accepted; water chemistry parameters observed in this study were similar among stations and, to a large degree, between seasons.

8.0 Recommendations

1) Propose de-listing the 9-mile portion of South Wyaconda River on the 303(d) list for sediment based on current macroinvertebrate bioassessment data.

2) Recognize the need for developing and incorporating satisfactory fish bioassessment protocols into the department's aquatic bioassessment program.

3) Conduct fish bioassessments of extensively channelized streams to further evaluate the relationship between protection of aquatic life designated use, habitat conditions, pool depths, and stream channel characteristics.

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Date: _____

Approved by: _____

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AR:dmt

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John Ford, QAPP Project Manager, WPP

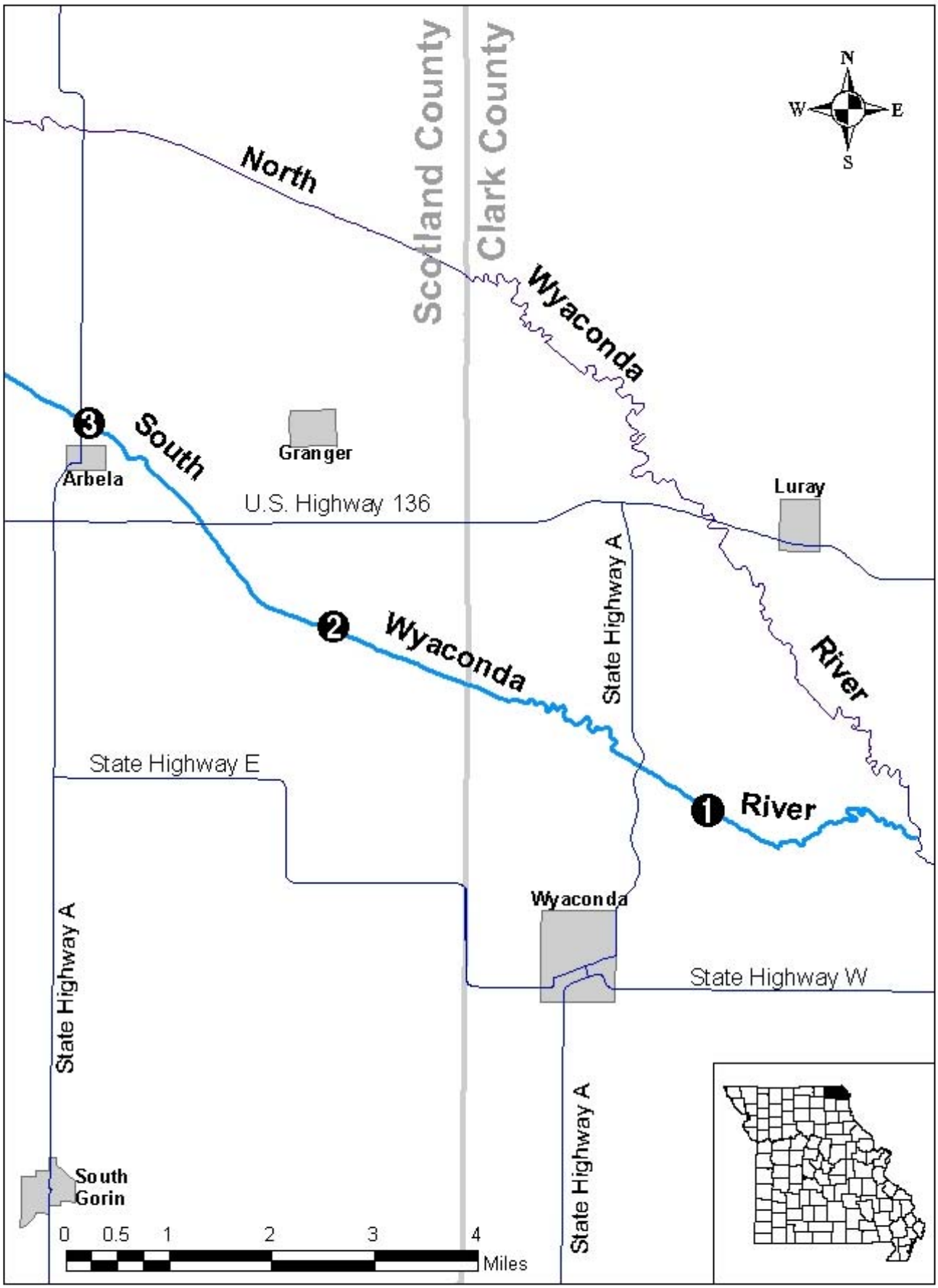
Appendix A

Maps

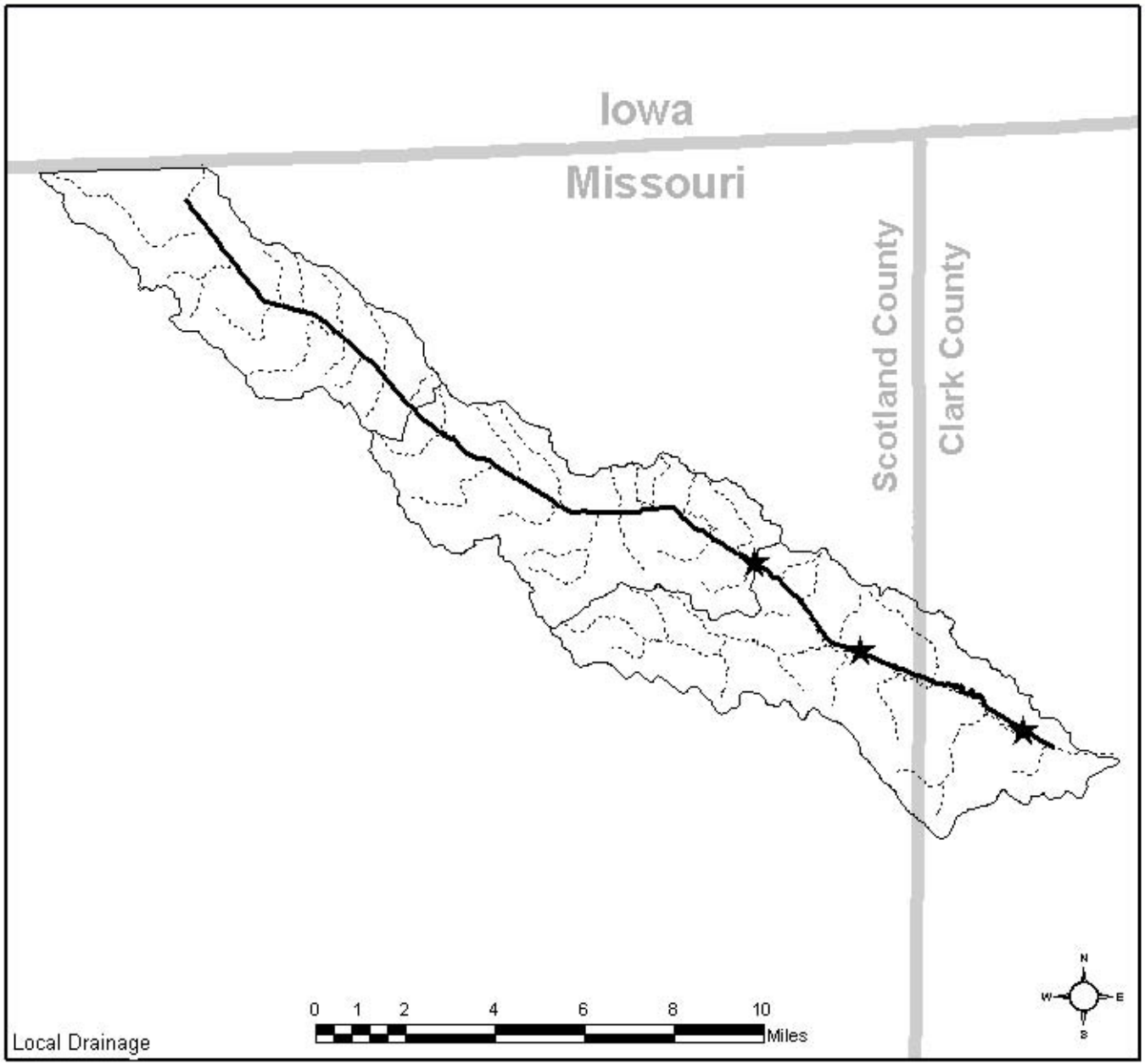
South Wyaconda River Sample Stations
Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU

&

South Wyaconda Study Area
Plains/Mississippi Tributaries between the Des Moines and Missouri Rivers EDU


Scotland County
Clark County
N
W
E
S
North
Wyaconda
River
3
South
Granger
Arbela
U.S. Highway 136
Luray
State Highway A
2
Wyaconda
River
State Highway E
1
River
Wyaconda
State Highway W
State Highway A
State Highway A
South
Gorin
0
0.5
1
2
3
4
Miles

South Wyaconda Study Site



Sampling Location

County Boundary

Local Drainage

South Wyaconda River

Local Drainage and Biologic Sampling Site Location

Ecolocial Drainage Unit (EDU) - An EDU is an area that contains a unique combination of habitats and organisms. Missouri is divided into 19 EDUs as shown in the inset map below. This site is located in the highlighted EDU.

Local Drainage - The local drainage area, also known as an 11 Digit Hydrologic Unit, is shown in the main map at left. This area includes the local watershed. Missouri is split into over 350 such units.

Ecological Drainage Unit

Appendix B

South Wyaconda River Macroinvertebrate Taxa Lists

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418725], Station #1, Sample Date: 9/21/2004 11:40:00 AM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina			2
AMPHIPODA			
Hyalella azteca	1	3	
COLEOPTERA			
Dubiraphia	7	2	
Helichus lithophilus		1	1
Hydroporus	1	3	
Tropisternus		-99	
DIPTERA			
Ablabesmyia	26	10	1
Chironomus	15		
Cladotanytarsus	31		5
Corynoneura	2		1
Cricotopus bicinctus		1	
Cricotopus/Orthocladius			1
Cryptochironomus	3		
Cryptotendipes	4		1
Dicrotendipes	10		19
Diplocladius		1	
Ephydridae	4	1	1
Glyptotendipes	1	1	
Hemerodromia		1	2
Labrundinia	1	12	
Micropsectra		1	
Nanocladius		15	1
Nilotanypus		1	
Ormosia	1		
Paracladopelma	4		
Paralauterborniella	2		
Paratanytarsus		4	
Paratendipes	1		
Phaenopsectra	2		1
Polypedilum	1		
Polypedilum convictum grp		2	6
Polypedilum fallax grp	1		2
Polypedilum halterale grp	2		
Polypedilum illinoense grp	22	7	2
Polypedilum scalaenum grp	16		1
Procladius	1		
Rheocricotopus		3	4
Rheotanytarsus	1	76	25
Simulium			3
Stempellinella	6		
Stenochironomus			5
Stictochironomus	4		

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418725], Station #1, Sample Date: 9/21/2004 11:40:00 AM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
Tabanus	1		
Tanytarsus	80	43	136
Thienemanniella	1		3
Thienemannimyia grp.	1	6	4
Tipula		1	
EPHEMEROPTERA			
Acentrella			5
Baetis		1	3
Brachycercus	2		
Caenis hilaris	8		1
Caenis latipennis	16	16	5
Hexagenia limbata	2		
Leptophlebiidae	2	60	1
Paracloeodes		1	3
Procloeon	7		5
Pseudocloeon		1	
Stenacron		1	3
Stenonema	1	2	3
Tricorythodes	1	14	2
LIMNOPHILA			
Physella		-99	
MEGALOPTERA			
Sialis		-99	
ODONATA			
Argia	1	7	
Calopteryx		1	
Enallagma		4	
Gomphus	1		
Libellula		-99	
Macromia		-99	
Progomphus obscurus	1		
TRICHOPTERA			
Agrypnia	1	1	
Cheumatopsyche		14	17
Nectopsyche	5	14	
Triaenodes		1	
TRICLADIDA			
Planariidae		2	
TUBIFICIDA			
Tubificidae		3	
VENEROIDEA			
Sphaeriidae		1	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418726], Station #2, Sample Date: 9/21/2004 1:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	1	
AMPHIPODA			
Hyalella azteca	1	16	2
COLEOPTERA			
Dubiraphia	4	5	
Helichus lithophilus		3	
Macronychus glabratus			1
DIPTERA			
Ablabesmyia	34	4	4
Ceratopogoninae	1		
Chironomus	12		
Cladotanytarsus	16		1
Corynoneura	2		
Cricotopus bicinctus		1	2
Cricotopus/Orthocladius	1	2	7
Cryptochironomus	3		
Cryptotendipes	2		
Dicrotendipes	4		44
Diptera	1		
Dolichopodidae	1		
Endochironomus	1		
Forcipomyiinae		1	3
Glyptotendipes		3	2
Harnischia	1		
Hemerodromia			2
Labrundinia		3	
Larsia			2
Nanocladius	2	20	2
Nilotanypus		2	1
Parachironomus		1	1
Paracladopelma	2		
Parakiefferiella		1	1
Paralauterborniella	3	1	
Paratanytarsus	4	4	1
Paratendipes	1		
Phaenopsectra	4		
Polypedilum			1
Polypedilum convictum grp		20	21
Polypedilum fallax grp	1	1	2
Polypedilum halterale grp	12		
Polypedilum illinoense grp	10	5	8
Polypedilum scalaenum grp	23		3
Prosimulium	1	3	11
Pseudochironomus			2
Rheocricotopus		6	15

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418726], Station #2, Sample Date: 9/21/2004 1:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
Rheotanytarsus	6	81	44
Simulium		4	
Stelechomyia			1
Stempellina	1		
Stempellinella	1		
Stenochironomus			11
Tanytarsus	60	75	176
Thienemanniella		2	15
Thienemannimyia grp.		14	11
Tipula	1		
Tribelos	2		
undescribed Empididae		1	
EPHEMEROPTERA			
Acentrella			1
Acerpenna		9	2
Baetis		8	24
Brachycercus	10		
Caenidae	6	20	3
Caenis hilaris	12	12	6
Caenis latipennis	20	8	1
Hexagenia	2		
Isonychia		2	-99
Leptophlebiidae	10	86	2
Procloeon	11		2
Stenacron	1	1	
Stenonema	2		
Tricorythodes	3	26	2
LIMNOPHILA			
Physella		1	
MEGALOPTERA			
Sialis	-99	-99	
ODONATA			
Argia		6	
Enallagma		2	
Gomphus	-99	-99	
Hetaerina		-99	
Macromia	-99	-99	
Progomphus obscurus	-99		
TRICHOPTERA			
Cheumatopsyche		79	39
Hydroptila		1	7
Nectopsyche		8	
Polycentropodidae		2	
Triaenodes		1	
TRICLADIDA			
Planariidae		2	
TUBIFICIDA			

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418726], Station #2, Sample Date: 9/21/2004 1:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
Enchytraeidae	2		
Tubificidae	3		
VENEROIDEA			
Sphaeriidae		1	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418727], Station #3, Sample Date: 9/22/2004 10:30:00 AM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca		16	
COLEOPTERA			
Dubiraphia	7	3	
Helichus lithophilus	1	5	
Hydroporus	1		
Scirtidae		1	
DIPTERA			
Ablabesmyia	29	2	5
Anopheles	1	1	
Ceratopogoninae	4		
Chironomus	6		
Cladotanytarsus	32		6
Corynoneura	2	2	
Cricotopus bicinctus	2	1	
Cricotopus/Orthocladius			3
Cryptochironomus	20		
Cryptotendipes	1		1
Dicrotendipes	2		21
Diptera	1		
Glyptotendipes			1
Hemerodromia		1	1
Labrundinia	6	5	4
Nanocladius	5		1
Paracladopelma	4		
Parakiefferiella	1		
Paralauterborniella	4		
Paratanytarsus	1	2	3
Paratendipes	1		
Phaenopsectra	1		1
Polypedilum convictum grp		1	4
Polypedilum fallax grp			2
Polypedilum halterale grp	10		
Polypedilum illinoense grp	24	15	14
Polypedilum scalaenum grp	11		7
Pseudochironomus			1
Rheocricotopus	2	3	6
Rheotanytarsus	4	87	23
Simulium		2	4
Stempellinella	6		1
Stenochironomus			5
Stictochironomus	1		2
Tanytarsus	54	35	133
Thienemanniella	4		9
Thienemannimyia grp.	2	1	8
Tipulidae	1	1	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0418727], Station #3, Sample Date: 9/22/2004 10:30:00 AM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
EPHEMEROPTERA			
Acerpenna			4
Baetis	1	1	2
Brachycercus	11		2
Caenis hilaris	30	17	15
Caenis latipennis	13	10	7
Hexagenia	6		
Isonychia		1	
Leptophlebiidae	4	50	2
Paracloeodes	3	3	2
Procloeon	8		3
Pseudocloeon		4	
Stenacron	2	4	1
Stenonema		1	
Tricorythodes	1	17	5
LIMNOPHILA			
Physella		-99	
ODONATA			
Argia		2	
Enallagma		4	
Gomphidae	1		
Progomphus obscurus	3	-99	
RHYNCHOBDELLIDA			
Glossiphoniidae		-99	
TRICHOPTERA			
Cheumatopsyche		36	11
Hydroptila			2
Nectopsyche		7	
Triaenodes		1	
TUBIFICIDA			
Tubificidae	1		1

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0503023], Station #1, Sample Date: 4/6/2005 10:35:00 AM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1		
AMPHIPODA			
Hyalella azteca		3	
COLEOPTERA			
Agabus		-99	
Dubiraphia	1		1
Helichus basalis		1	
Helichus lithophilus		3	
Paracymus	1		
DIPTERA			
Ablabesmyia	1		
Ceratopogoninae	3		
Cladotanytarsus	13		
Cricotopus/Orthocladius	39	19	191
Cryptochironomus	11	1	
Cryptotendipes	7		
Dicrotendipes	3	1	8
Hemerodromia		3	1
Hydrobaenus	56		3
Labrundinia	1	5	
Nanocladius	3	7	
Paracladopelma	4		
Parametriocnemus	1		
Paratanytarsus	8	28	4
Paratendipes	3		
Polypedilum convictum grp	8	20	40
Polypedilum fallax grp			5
Polypedilum illinoense grp			11
Polypedilum scalaenum grp	27	2	15
Pseudochironomus			1
Rheocricotopus		2	2
Rheotanytarsus	2	49	13
Saetheria	16		5
Simulium			3
Stenochironomus			3
Tanytarsus	51	137	60
Thienemannimyia grp.	3	19	17
Zavrelimyia	1		
EPHEMEROPTERA			
Acentrella		2	2
Acerpenna	1	8	3
Caenis latipennis	7	15	2
Heptagenia		1	
Heptageniidae	1	2	1
Leptophlebia	3	1	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0503023], Station #1, Sample Date: 4/6/2005 10:35:00 AM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
MEGALOPTERA			
Sialis	-99		
ODONATA			
Calopteryx		-99	
Gomphus	3		
Progomphus obscurus	3		
TRICHOPTERA			
Cheumatopsyche	12	21	
Nectopsyche		3	
TUBIFICIDA			
Enchytraeidae	2		
Limnodrilus hoffmeisteri	1		
Tubificidae	2		

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0503024], Station #2, Sample Date: 4/6/2005 12:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Crangonyx		-99	
Hyalella azteca		2	-99
COLEOPTERA			
Dubiraphia	2	3	
Peltodytes		1	
DIPTERA			
Ablabesmyia	2	1	
Ceratopogoninae	5	1	
Chrysops	1		
Cladotanytarsus	7		3
Cricotopus bicinctus	2	6	
Cricotopus/Orthocladius	23	31	133
Cryptochironomus	4	1	1
Cryptotendipes	2		
Dicrotendipes	1		8
Hydrobaenus	32		3
Labrundinia		13	
Nanocladius	4	6	
Nilotanypus		1	
Nilothauma		1	
Paracladopelma	1		
Paratanytarsus	6	54	11
Paratendipes	8		
Phaenopsectra	3		5
Polypedilum convictum grp	2	6	19
Polypedilum fallax grp			3
Polypedilum halterale grp	21		
Polypedilum illinoense grp	19	28	9
Polypedilum scalaenum grp	18	1	1
Rheocricotopus			1
Rheotanytarsus		30	28
Saetheria	49	1	2
Simulium	2		2
Stelechomyia			1
Stenochironomus			3
Tanytarsus	49	89	74
Thienemannimyia grp.	1	19	6
Tribelos	1		
Zavrelimyia	1	2	
EPHEMEROPTERA			
Acentrella			2
Acerpenna		4	4
Caenis latipennis	13	4	2
Heptagenia		1	
Leptophlebia	6	3	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0503024], Station #2, Sample Date: 4/6/2005 12:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
MEGALOPTERA			
Sialis	1		
ODONATA			
Argia		3	-99
Calopteryx		-99	
Enallagma		3	
Gomphus		1	
Ischnura		1	
Progomphus obscurus	1		
TRICHOPTERA			
Cheumatopsyche		3	5
Nectopsyche		2	
Triaenodes		1	
TUBIFICIDA			
Enchytraeidae	1		
Limnodrilus hoffmeisteri		2	
Tubificidae	1	1	
VENEROIDEA			
Sphaeriidae	1	1	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0503025], Station #3, Sample Date: 4/6/2005 1:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1		
AMPHIPODA			
Hyalella azteca		1	
COLEOPTERA			
Dubiraphia	2	1	
Helichus basalis		2	
Helichus lithophilus		1	
Peltodytes	1		
DIPTERA			
Ablabesmyia	1		
Ceratopogoninae	2		
Cladotanytarsus	2	1	1
Corynoneura		2	
Cricotopus bicinctus	2	6	5
Cricotopus/Orthocladius	13	39	98
Cryptochironomus	4	1	
Dicrotendipes	3	2	18
Glyptotendipes			1
Hydrobaenus	12	5	9
Labrundinia	2	7	
Nanocladius	3	5	
Nilothauma			1
Paracladopelma	1		
Parametriocnemus		1	
Paraphaenocladius	1		
Paratanytarsus	13	25	8
Paratendipes	28		
Pericoma	1		
Phaenopsectra	7	2	14
Polypedilum convictum grp	2	6	13
Polypedilum fallax grp			5
Polypedilum halterale grp	13		
Polypedilum illinoense grp	8	18	12
Polypedilum scalaenum grp	9		3
Rheocricotopus			1
Rheotanytarsus	3	21	12
Saetheria	21		22
Simulium	1		4
Tanytarsus	41	86	100
Thienemannimyia grp.	1	14	12
Tipula		1	
Zavrelimyia	1		
EPHEMEROPTERA			
Acerpenna		29	1
Caenis latipennis	5	4	

Aquid Invertebrate Database Bench Sheet Report

South Wyaconda R [0503025], Station #3, Sample Date: 4/6/2005 1:15:00 PM

NF = Nonflow, RM = Rootmat, SG = Woody Debris

A value of -99 indicates that the species was found, but the exact number of species was not determined.

ORDER: TAXA	NF	RM	SG
Centroptilum		1	
Heptagenia		6	-99
Hexagenia limbata	1		
Leptophlebia	3	3	
Paraleptophlebia	1		
Stenacron			1
Stenonema terminatum	3		
HEMIPTERA			
Trichocorixa	1		
LUMBRICULIDA			
Lumbriculidae	1		
ODONATA			
Argia		2	
Enallagma		1	
Progomphus obscurus	-99		
PLECOPTERA			
Perlesta		1	
TRICHOPTERA			
Cheumatopsyche	1	9	1
TUBIFICIDA			
Limnodrilus hoffmeisteri	1		